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Does Trade Openness Reduce Inflation? Empirical Evidence from Pakistan

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One of the more celebrated propositions found in every international trade text is the case that trade liberalization is associated with declining prices, so that protectionism is inflationary. In line with this view Romer (1993) postulates a hypothesis that inflation is lower in small and open economies. The objective of this study is to examine the Romer's hypothesis in Pakistan. For this purpose multivariate cointegration and Vector Error Correction Model (VECM) techniques have been applied. The study covers the time period from 1960 to 2007. The empirical findings under cointegration test have shown that there is a significant negative long run relationship between inflation and trade openness, which confirms the existence of Romer's Hypothesis in Pakistan.

I. Introduction

One of the more celebrated propositions found in every international trade text is the case that trade liberalization is associated with declining prices, so that protectionism is inflationary. In today's world no developing country can afford to isolate itself from the world economy. The benefits of outward-looking policies that help in taking advantage of the possibilities of international trade and capital flows are extensively discussed in the literature. In the 1990s, economic liberalization, globalization and openness have become the buzzwords. There has been a distinct shift in favor of greater integration of the world economy. The trend has been towards greater opening up and there is evidently a move away from the typical closed economy structure in most of the developing economies.

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Sustained low inflation has been a stylized fact of the late 1990s and early 2000s, both in advanced and increasingly in emerging markets. Some have argued that these developments could reflect stiffer global competition and the increased weight of developing countries in the global trading system (Rogoff, 2003). The relationship between inflation and openness has been a subject of research, theoretical as well as empirical. However, the literature on the subject is relatively scant. According to 'New Growth Theory', openness is likely to affect inflation through its likely effect on output (Jin, 2000). This link could be operating through: a) increased efficiency which is likely to reduce cost through changes in composition of inputs procured domestically and internationally, b) better allocation of resources, c) increased capacity utilization, d) rise in foreign investment which can stimulate output growth and ease pressures on prices (Ashra 2002).

When we move on to a review of some of the existing empirical studies of the relationship between openness and inflation, we find inconclusive evidence suggesting that greater openness is associated with lower trend inflation. Romer (1993) finds closed economies tend to have higher inflation. He argues that central banks in economies more open to trade find currency fluctuations caused by money surprises more painful and therefore exercise more restraint than their closed economy counterparts. Several studies have tested Romer's argument in different ways and have supported the conventional view of the negative relationship between trade openness and inflation. Thus empirical findings of Lane (1997), Ashra (2002), Sachsida *et al.* (2003), Yanikkaya (2003), Gruben and Mcleod (2004), Kim and Beladi (2004), Daniels et al. (2005), Razin and Loungani (2005), Aron and Muellbauer (2007), Badinger (2007), Bowdler and Nunziataz (2007) have validated Romer's argument. However, Terra (1998) marginally supports Romer's argument by claiming that the negative correlation is only evident in severely indebted countries during 1980s crisis period. Similarly, Batra (2001) argues that tariff does not necessarily cause inflation at least in the United States. The findings of Gruben and Mcleod (2004) show that there does not exist any significant openness–inflation relationship among OECD economies. Kim and Beladi (2004) have estimated a positive relationship between price level and trade openness for some advanced economies, such as the U.S., Belgium and Ireland while for other countries, both developed and developing included in the study, their finding is in line with Romer's argument. Finally it is interesting to

note that Romer (1993) himself finds no significant openness–inflation relationship among OECD economies.

Most studies of the role of openness have focused upon the estimation of cross-country averages of many different levels of economies. However, these studies cannot identify country-specific differences. Little has been done for dynamics of the impact of openness on inflation at a country level. The literature on trade openness-inflation association is scarce in Pakistan. Ashra (2002), Kim and Beladi (2004) and Gruben and Mcleod (2004) have reported evidence of negative relationship between trade openness and inflation for Pakistan under panel data framework. However, we have come across only one study on Pakistan that has used time series data. Hanif and Batool (2006) have tested Romer's hypothesis for Pakistan economy using annual time series data for the period 1973-2005. They find that besides the conventional explanatory variables like real GDP growth, monetary growth, interest rate, and wheat support price, the openness variable such as growth in 'overall trade to GDP ratio' also has significant negative impact on the domestic price growth in Pakistan. However, this study suffers from a serious limitation as it has used a small number of observations (i.e.32 in all) for carrying out their analysis using Heteroscedasticity and Autocorrelation Consistent (HAC) Standards Errors estimation technique. This technique is only valid in large samples and may not be appropriate in small samples (Gujarati, 2003). Thus, in the presence of relatively small data, the study is unable to provide some conclusive results. Therefore, there is a need to reexamine the issue using relatively larger data set and some more sophisticated estimation technique for getting more reliable findings. This study is an attempt in this direction.

Until the mid 1980, Pakistan pursued an economic policy that was strongly interventionist. During the late 1980s, Pakistan turned from inward-looking policies towards trade liberalization and export promotion strategies. From the late 1980s onwards, the governments changed frequently but all of them considerably liberalized the economy. But despite making the economy steadily open, inflation has not been maintained within the desirable limits in Pakistan. Therefore, the objective of the study is to determine the nature of relationship between inflation and trade openness in Pakistan.

Rest of the study is organized as follows: The theoretical model, sources of data and estimation technique are described in Section II. Section III presents the discussion on the estimated results. Final Section concludes the study.

II. Model, Data and Estimation

Inflation is a complex process and it is very difficult to construct an empirical model for a country. However, it is possible to find the key variables impacting the inflation process in a country like Pakistan. The most common empirical method to examine the trade openness-inflation relationship has been to employ a single equation model for inflation, treating trade openness as an exogenous variable among others. Solomon and de Wet (2004) have used a four variable single equation model where budget deficit (BD), gross domestic product (GDP) and exchange rate (ER) are treated as an exogenous variables and inflation (CPI) as an endogenous variable. I have just added trade openness (TO) as an exogenous variable in their model. Thus we have estimated the following model

$$LCPI_t = \alpha_1 + \alpha_2 LBD_t + \alpha_3 LER_t + \alpha_4 TO_t + \alpha_5 LGDP_t + u_t \qquad (1)$$

where $LCPI_t, LBD_t, LER_t, TO_t$ and $LGDP_t$ represent consumer price index, budget deficit, exchange rate, trade openness and gross domestic product respectively expressed in natural logarithms except for trade openness at time t. u is stochastic error term.

Now a brief discussion on the expected relationship between inflation and all the explanatory variables of the above model is presented. The influence of the budget deficit on inflation is positive. The higher the budget deficit, the greater will be the rate of inflation. The budget deficit affects inflation only if it is monetized to increase the monetary base of the economy. From Friedman's theory of money inflation is a monetary phenomenon. Accordingly, if the budget deficit is monetized it increases the money supply thereby increasing the price level. When the budget deficit is monetized, an extremely high correlation exists between the budget deficit and money supply. The problem of multicollinearity and reducibility precludes one from using both money supply and the budget deficit as explanatory variables in the regression analysis. Therefore, in

order to estimate the effect of the budget deficit on inflation, the budget deficit is used as explanatory variable instead of the money supply. The exchange rate has a deterministic effect on the level of prices in underdeveloped economies. In countries like Pakistan, an exchange rate depreciation (appreciation) could increase (decrease) the price of imported commodities. Pakistan's markets are significantly based on imported commodities, which imply the depreciation of the exchange rate could be immediately reflected on an increase on the price of the consumer's basket of commodities.

Expected impact of trade openness on inflation is negative because direct and indirect price effects of cheaper imports of finished goods and intermediate inputs may net out to a decline in the overall price level. Additionally, opening an economy to the rest of the world may alter the incentives to which central banks respond in determining a country's long-run inflation rate. Finally openness could also lead to lower inflation indirectly by fostering faster domestic productivity growth as a result of increased competition. Because trade enables countries to specialize in the activities in which they have a comparative advantage, sectors in which countries are relatively inefficient shrink, while sectors in which countries have a comparative advantage expand. Faster productivity growth allows firms to pay higher wages without passing these costs on in the form of higher prices. The fourth important explanatory variable is the level of GDP, which has expectedly a negative impact on inflation rate as availability of goods and services in the economy eases pressure on the domestic price growth[1].

Time span covered in this study is from 1960 to 2007 and I have used annual time series data. The main focus of this paper is on inflation rate and trade openness (TO). Inflation rate is proxied using logarithm of the composite consumer price index (CPI). The control of inflation, measured as the annual growth rate of this variable, is the main goal of monetary policy and State Bank of Pakistan (SBP) sets a target. The most commonly used measure of openness in practice is the sum of imports and exports divided by GDP. This ratio generally reveals the degree of a country's openness to world trade: The more open a

[1] There is a vast literature on inflation and growth. I did not go into the details of it.

domestic economy, the less is the restriction in world trade, and the higher is the trade share in GDP. No doubt, there are various other possible measures that could be used as a proxy for openness but it is difficult to obtain long historical time series for most of these (Ashra, 2002). So, I have restricted myself to trade to GDP ratio, which indicates the overall openness of the economy. Other variables included in the analysis are government budget deficit (BD), exchange rate (ER), and Gross Domestic product (GDP). The data, seasonally unadjusted and expressed in nominal terms, have been obtained from various issues of *Economic Survey,* Government of Pakistan and *International Financial Statistics*, IMF.

II.1. Unit Root Test

Since macroeconomic time-series data are usually non-stationary (Nelson and Plosser, 1982) and thus conducive to spurious regression, we test for stationarity of a time series at the outset of cointegration analysis. As testing for a unit root is an active research area, several testing procedures have been developed over the years. Many of these tests are designed to overcome difficulties encountered in practice. In this regard, the present study has conducted an Augmented Dickey-Fuller (ADF) test, which is based on the t-ratio of the parameter in the following regression.

$$\Delta X_t = \kappa + \phi t + \Theta_i X_{t-i} + \sum_{i=1}^{n} \varphi_i \Delta X_{t-i} + \varepsilon_t \qquad (2)$$

where X is the variable under consideration, Δ is the first difference operator, t captures any time trend, ε_t is a random error, and n is the maximum lag length. The optimal lag length is identified so as to ensure that the error term is white noise. While $\kappa, \phi, \Theta \text{ and} \varphi$ are the parameters to be estimated. If we cannot reject the null hypothesis $\Theta = 0$, we conclude that the series under consideration has a unit root and is therefore non-stationary.

However, the ADF unit root test is known to lose power dramatically against stationary alternatives with a low order MA process: a characterization that fits well to a number of macroeconomic time series. Consequently, along the lines of ADF test, a more powerful variant is the Dicky-Fuller Generalized Least Square (DFGLS) de-trending test

proposed by Elliott, Rothenberg and Stock (ERS, 1996). This test is similar to an Augmented Dickey-Fuller test, but has the best overall performance in terms of small-sample size and power, dominating the ordinary Dickey-Fuller test. Therefore, to check the stationary of variables, I have also used the DFGLS test.

It is essential at the onset of cointegration analysis that we should solve the problem of optimal lag length because multivariate cointegration analysis, which we are going to conduct in the study, is very sensitive to lag length selection. The two most commonly used lag length selection criteria are the Akaike Information Criterion (AIC) and the Schawartz Bayesian Criterion (SBC).

II.2.Cointegration Test

The econometric framework used for analysis in the study is the Johansen (1998) and Johansen and Juselius (1990) Maximum-Likelihood cointegration technique, which tests both the existence and the number of cointegration vectors. This multivariate cointegration test can be expressed as:

$$Z_t = K_1 Z_{t-1} + K_2 Z_{t-2} + ... + K_{k-1} Z_{t-k} + \mu + v_t \qquad (3)$$

Where

$Z_t = (CPI, BD, ER, TO, GDP)$ i.e. a 5 x 1 vector of variables that are integrated of order one [i.e. *I* (1)],*CPI, BD, ER, TO* and *GDP* are price level, budget deficit, exchange rate, trade openness and gross domestic product respectively

$\mu =$ a vector of constant and

$v_t =$ a vector of normally and independently distributed error term.

The equation (3) can be reformulated in a vector error correction model (VECM) as follows:

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \cdots\cdots + \Gamma_{k-1} \Delta Z_{t-k-1} + \Pi Z_{t-1} + \mu + v_t \qquad (4)$$

where, $\Gamma_i = (I - A_1 - A_2 \ldots\ldots - A_i)$ $(i = 1,2,3\ldots\ldots k-1)$ and $\Pi = -(I - A_1 - A_2 - A_3 \ldots\ldots - A_k)$. The coefficient matrix Π provides information about the long run relationships among the variables in the data. Π can be factored into $\alpha\beta'$ where α will include the speed of adjustment to the equilibrium coefficients while the β' will be the long run matrix of coefficients. The presence of r cointegrating vectors between the elements of Z implies that Π is of the rank $r(0 < r < 5)$. To determine the number of cointegrating vectors, Johansen developed two likelihood ratio tests: Trace test (λ_{trace}) and maximum eigenvalue test (λ_{max}.).If there is any divergence of results between these two tests, it is advisable to rely on the evidence based on the λ_{max} test because it is more reliable in small samples (see Dutta and Ahmed, 1997 and Odhiambo, 2005).

III. Results and Discussion

The first step in cointegration analysis is to test the unit roots in each variable.[2] To this end, firstly I apply Augmented Dickey-Fuller (ADF) stationary tests on LCPI, LBD, LER, TO and LGDP[3]. From the results of the ADF test presented in the table 1, it is evident that all the times series used in the study are stationary at first difference as expected. It implies that they are integrated of order one i.e. *I(1).*Similar results for all macroeconomic variables have been found under the DFGLS test[4]. For getting optimal lag length for cointegration analysis, I have used two criteria, namely the Akaike Information Criteria (AIC) and the Schwarz Bayesian Criteria (SBC). The SBC has suggested a lag length of 1 as optimal, while the AIC has indicated 3 as optimal lag length (See table A2 in Appendix). However, I have selected optimal lag length 1 as suggested by the SBC because when I use the lag length 3 for cointegration analysis, I find no cointegrating vector under both trace and maximum eigen statistics, while at lag length 1, I get one cointegrating vector under both these statistics.

[2] Since the cointegration methodology involves finding a stationary linear combination of a set of variables, which are themselves non-stationary, therefore, a precondition for cointegration to be held is that all variables should be non-stationary.
[3] All the variables are logarithmic except trade openness.
[4] See table A1 in the Appendix.

Table 1.Augmented Dickey Fuller (ADF) Unit Root Tests

Variables	Level	First Difference	Mackinnon Critical Values for Rejection of Hypothesis of a Unit Root 1 %	5 %	10 %	Decision	Order of Integration
LCPI	6.7906	-1.6213	-2.583	-1.94	-1.62	Nonstationary at level but stationary at first difference	*I* (1)
LBD	-0.0508	-10.439	-2.583	-1.94	-1.62	Nonstationary at level but stationary at first difference	*I* (1)
LEX	1.2831	-7.0888	-2.583	-1.94	-1.62	Nonstationary at level but stationary at first difference	*I* (1)
TO	-2.1076	-3.7438	-2.583	-1.94	-1.62	Nonstationary at level but stationary at first difference	*I* (1)
LGDP	4.9091	-4.4760	-2.583	-1.94	-1.62	Nonstationary at level but stationary at first difference	*I* (1)

Cointegration relationship among CPI, BD, ER, TO and GDP has been investigated assuming linear trend in data, and both an intercept and a trend in the cointegrating equation using the Johansen technique. Table 2 reports our cointegration test results based on Johansen's maximum likelihood method. Both trace statistic (λ_{trace}) and

maximal eigenvalue (λ_{max}) statistic indicate that there is at least one cointegrating vector among all the five time series.We can reject the null hypothesis of no cointegrating vector in favour of one cointegrating vector under both test statistics at 5 percent level of significance. We also cannot reject the null hypothesis of at most one cointegrating vector against the alternative hypothesis of two cointegrating vectors, for both the trace and max-eigen test statistics. Consequently, we can conclude that there is only one cointegrating relationship among CPI, BD, ER, TO and GDP. This implies that price level, budget deficit, exchange rate, trade openness and gross domestic product establish a long run relationship in Pakistan.

Table 2.Cointegration Test Based on Johansen's Maximum Likelihood Method

Null Hypothesis	Alternative Hypothesis			Critical Values	
				95 %	P-values●●
λ_{trace} rank tests		Eigen values	λ_{trace} rank value		
$H_0 : r = 0$	$H_1 : r = 1$	0.682256	103.3127***	76.97277	0.0001
$H_0 : r = 1$	$H_1 : r = 2$	0.391552	51.71982	54.07904	0.0799
$H_0 : r = 2$	$H_1 : r = 3$	0.262939	29.36187	35.19275	0.1856
$\lambda_{\max}$ rank tests			$\lambda_{\max}$ rank value		
$H_0 : r = 0$	$H_1 : r > 0$	0.682256	51.592***	34.80587	0.0002
$H_0 : r \leq 1$	$H_1 : r > 1$	0.391552	22.35795	28.58808	0.2542
$H_0 : r \leq 2$	$H_1 : r > 2$	0.262939	13.72878	22.29962	0.4871

Normalized Cointegrating Equation:

LCPI=1.987 + 0.102*LBD + 0.388*LEX - 0.681*TO - 0.421*LGDP
(2.031)** (13.116)*** (2.514)** (-4.732)*** (-4.236)***

***denotes rejection of the null hypothesis at the 1 percent significance level.
** denotes rejection of the null hypothesis at the 5 percent significance level.
●● MacKinnon-Haug-Michelis (1999) p-values.

Trace test indicates 1 cointegrating equation at 1 percent significance level.

Max-eigenvalue test indicates 1 cointegrating equation at 1 percent significance level.

The cointegrating equation, which is given at the bottom of the table 2, normalized for LCPI just to get meanings from the coefficients. All the explanatory variables significantly affect CPI. The coefficients of all the logarithmic variables may be interpreted in terms of elasticity. So it can be stated that 1 percent increase in BD is associated with 0.10 percent increase in CPI in Pakistan. Since the parameter of budget deficit is significant, it implies that there is a significant long run relationship between inflation and budget deficit. This result is in accordance with the findings of Chaudhary and Ahmad (1995) and Agha and Khan (2006) that budget deficit ultimately induces inflation in Pakistan. There exists a positive relationship between LCPI and LEX in such a way that 1 percent increase in nominal exchange rate results in 0.38 percent increase in inflation rate in the country. It implies that it is not recommended for the authorities to implement a flexible exchange rate system because that may lead to a major depreciation that will create inflationary problem. The coefficient of trade openness carries negative sign, which shows that 1 unit increase in trade openness brings 0.68 percent decrease in inflation rate. This finding is consistent with the empirical findings of Romer (1993), Kim and Beladi (2004), Ashra (2002) and Gruben and Mcleod (2004) among many others. Furthermore, it validates the results of Hanif and Batool (2006) that openness has significant negative impact on the domestic price growth in Pakistan. This finding confirms the existence of Romer's hypothesis in Pakistan that inflation is lower in small and open economies. Furthermore, it indicates that the traditional closed economy explanation for inflationary process remains important and adding the openness variables in the analysis complements the analytical and empirical perspective. Finally there is a significant negative relationship between CPI and GDP such that 0.42 percent decrease in CPI is associated with 1 percent increase in GDP.

A principal feature of cointegrated variables was that their time paths were influenced by the extent of any deviation from the long run equilibrium (Walter Anders, 1995). Error correction term represents

percent of correction to any deviation in long run equilibrium price in a single period and also represents how fast the deviations in the long–run equilibrium are corrected. The coefficient of the ECT of inflation variable carries the correct sign (negative) and statistically significant at 10 percent level with the speed of convergence to equilibrium of 27 percent (Table 3). It means that whenever there is any disturbance in the system in the long run, in every short run period 27 percent correction to disequilibrium will take place. The over all restoration to equilibrium will happen in almost 4 years. It indicates the stability of the model. The coefficients of the error correction terms of trade openness, exchange rate and GDP are statistically significant but they carry positive sign. It means that in case of any disturbance, divergence from the equilibrium path will take place and the whole system cannot be brought to equilibrium position in each case. The coefficient of error correction term of budget deficit is not only insignificant but also carries incorrect sign i.e. positive. The insignificance of the ECT component for this variable indicates that this variable is weakly exogenous to the model. The diagnostic tests involve χ^2 tests for the hypothesis that there is no serial correlation; that the residual follow the normal distribution; that there is no heteroscedasticity; and lastly that there is no autoregressive conditional heteroscedasticity. In all equations the diagnostics suggest that the residuals are Gaussian as the Johansen method presupposes.

Table 3.Summary Results from VECMs and Diagnostic Tests

	$\Delta L(CPI)$	$\Delta L(BD)$	$\Delta L(EX)$	$\Delta L(TO)$	$\Delta L(GDP)$
Constant	0.026 (2.737)***	0.177 (0.880)	0.121 (3.667)**	0.043 (1.576)**	0.038 (1.857)**
ECT(-1)	- 0.275 (1.898)*	1.761 (1.683)	0.417 (2.422)**	0.853 (5.887)***	0.102 (0.952)
R^2	0.684	0.277	0.548	0.604	0.391
Adjusted R^2	0.633	0.163	0.477	0.543	0.354
S.E. of Regression	0.032	0.669	0.111	0.093	0.068
Diagnostic Tests	χ^2 (p values are in the parenthesis)				
Serial Correlation (Breusch–Godfrey serial LM)	1.24(0.441)	0.791(0.557)	1.31(0.262)	2.15(0.156)	1.34(0.238)
Heteroscedasticity (White eteroskedasticity Test)	0.04(0.982)	1.33(0.268)	1.351(0.252)	2.27(0.157)	0.084(0.897)
Normality (Jorque-Bera)	0.411(0.644)	0.774(0.361)	0.524(0.391)	2.3(0.194)	0.46(0.78)
AR.Cond. Heteroscedasticity (ARCH LM Test)	0.007(0.938)	1.344(0.261)	0.004(0.964)	1.247(0.285)	1.086(0.337)

Note: t-values given in parenthesis with, ***, **, *, indicate significance at 1 pertcent, 5 percent and 10 percent probability level respectively.

V. Conclusion

Inflation has always been a concern for the policy makers as it creates uncertainty in the economy that may adversely affect economic growth. Therefore, maintaining noninflationary stable economic growth has been at the core of macroeconomic policies in Pakistan like in many other developing countries. The concern with inflation stems not only from the need to maintain overall macroeconomic stability, but also from the fact that inflation hurts the poor particularly hard as they do not possess effective inflation hedges.

An important debate has centered on the effects of openness (in the trade-flow sense) on inflation. Theoretically, two alternative views have been espoused concerning the issue. One of these states the openness causes a slower rate of inflation, while the other states that openness causes a faster rate of inflation. Many empirical studies have been performed to test these hypotheses. But still there is inconclusive evidence in support of these two views.

Like in other developing countries maintaining low inflation without hurting the economic growth of the economy are the main macroeconomic policy objectives in Pakistan. Inflation is complex process and developing an empirical model for the same is not an easy task. The main objective of this paper is to apply cointegration approach in order to reexamine whether the hypothesis proposed by Romer (1993), that there is a negative relation between inflation and trade openness holds for Pakistan. The study has used annual observations for the period 1960 to 2007.The results obtained corroborate Romer's proposition. In a summarized manner, this study further supports the results obtained by Romer (1993), demonstrating that there is a negative relation between openness and inflation. Thus, whatever its cause, that greater openness to trade is associated with lower inflation should provide some comfort to those who fear trade liberalization and flexible exchange rates increase macroeconomic instability in Pakistan.

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Appendix

Table A1. DF-GLS Unit Root Tests

Variables	Level	First Difference	Mackinnon Critical Values for Rejection of Hypothesis of a Unit Root			Decision	Order of Integration
			1 %	5 %	10 %		
LCPI	-0.438	-4.935	-3.77	-3.19	-2.89	Nonstationary at level but stationary at first difference	*I* (1)
TO	-1.955	-4.959	-3.77	-3.19	-2.89	Nonstationary at level but stationary at first difference	*I* (1)
LRGDP	-3.497	-6.375	-3.77	-3.19	-2.89	Nonstationary at level but stationary at first difference	*I* (1)
LEX	-2.151	-7.436	-3.77	-3.19	-2.89	Nonstationary at level but stationary at first difference	*I* (1)
LBD	-2.101	-7.523	-3.77	-3.19	-2.89	Nonstationary at level but stationary at first difference	*I* (1)

Table A2.Lag Order Selection

Lag	AIC	SC
0	1.776864	1.981655
1	-7.158782	-5.930038*
2	-7.945100	-5.692402
3	-8.880952*	-5.604301
4	-8.698020	-4.397415

* indicates lag order selected by the criterion
AIC: Akaike information criterion
SC: Schwarz information criterion